3. PREVIOUS INVESTIGATIONS

Previous investigations at AA 3 include the following:

- Literature and record search
- Site visit and visual inspection
- Groundwater sample collection after installing four monitoring wells
- Soil vapor sample collection after installing three vadose zone vapor wells
- Geophysical Investigation
- Exploratory trenching, including collection of subsurface soil samples for laboratory analysis

The sampling locations and other relevant information from previous investigations are presented in Figure 3-1. A literature and record search was conducted during early 1999, and the BCT conducted a site visit and visual inspection of the area during August 1999. IT/OHM was contracted to install monitoring wells and vadose zone wells, conduct a geophysical investigation of the area, advance exploratory trenches at the site, and conduct a radiological screening survey as part of the exploratory trenching activity. A technical information package compiling the results of the data collected (IT/OHM 2000) was submitted to the BCT.

3.1 WELL INSTALLATION

The *Technical Information Package* (IT/OHM 2000) refers to the monitoring and vadose zone wells of AA 3 with "MSCR1" preceding the well numbers; however, this prefix was dropped during the preparation of the RSE work plan. During October 1999, four monitoring wells were installed at the site (MW01, MW02, MW03, and MW04) to evaluate the groundwater elevations and flow direction at the site. Wells MW01, MW02, and MW04 were installed as downgradient wells, and well MW03 was installed as an upgradient well. Figure 3-1 shows the locations of these wells.

Three vadose zone wells were also installed (PZ1, PZ2, and PZ3) in October 1999. Wells PZ1, PZ2, and PZ3 have total depths of 22 feet (screened interval 17 to 22 feet), 30 feet (screened interval 25 to 30 feet) and 26 feet bgs (screened interval 15 to 20 feet), respectively.

3.2 GROUNDWATER SAMPLING

Two rounds of groundwater sampling were conducted (4 November 1999 and 20 April 2000) at the four monitoring wells located at AA 3 (MW01, MW02, MW03, and MW04). The groundwater samples were analyzed for total petroleum hydrocarbons (TPH), VOCs, metals, mercury, perchlorates, nitrates, lead, gross alpha and gross beta radiation, and the following radioisotopes: uranium isotopes, radium, thorium isotopes, americium, and lead^{210}.

None of the groundwater samples had concentrations exceeding the maximum contaminant levels (MCLs) for VOCs, metals, perchlorate, or radionuclides, except as indicated in Table 3-1. Further discussion on the radionuclides in groundwater at MCAS El Toro is presented in Section 3.3.1 of this report.

Table 3-1: Summary of Detected Analytes Exceeding MCLs – Groundwater Sampling – Previous Investigation

Well ID	Sample ID	Sampling Date	Total Dissolved Solids Secondary MCL = 500 mg/L (mg/L)	Manganese Secondary MCL = 50 µg/L (µg/L)	Gross Alpha MCL = 15 pCi/L (pCi/L)	Total Uranium MCL = 20 pCi/L (pCi/L)
MW01	20242-987	11/4/1999	1,760	80.2	34.6 ± 5.27	NA
	20242-1123	4/20/2000	NA	20 U	27.6 ± 6.0	38.4
MW02	20242-984	11/4/1999	1,920	259	23.5 ± 4.29	NA
	20242-1124[a]	4/20/2000	NA	43.3	28.3 ± 6.0	31.63
MW03	20242-989[b]	11/4/1999	1,740	20.9	35.5 ± 5.23	NA
	20242-1120	4/20/2000	NA	20 U	35.7 ± 6.8	50.02
MW04	20242-981	11/4/1999	2,290	48.1	45.9 ± 8.5	56.01
	20242-1122	4/20/2000	NA	20 U	Greater than 15	NA

Notes:
[a] Chromium was reported at 357 µg/L.
[b] Selenium was reported at 50.3 µg/L.
pCi/L = picoCuries per liter
µg/L = micrograms per liter
MCL = maximum contaminant level
mg/L = milligrams per liter
NA = not analyzed
Values shown in bold text are above MCLs.

3.3 PERIMETER SOIL GAS SAMPLING

Two rounds of soil vapor sampling were conducted on 4 November 1999 and 24 July 2000 at each of the three wells (PZ-1 through PZ-3). The samples were analyzed for VOCs and fixed gases (carbon dioxide, carbon monoxide, methane, nitrogen, and oxygen).

Methane was not detected in any of the samples; all VOCs that were detected were at concentrations below 1 microgram per liter (µg/L). The detected compounds for each vadose zone well for both sampling events are given in Table 3-2.

Table 3-2: Summary of Detected Analytes – Perimeter Soil Gas Sampling – Previous Investigation

Well ID	Sampling Date	Detected Compounds
PZ1	11/4/1999	Dichlorodifluoromethane
	7/24/2000	Chloromethane, m/p-xylene, toluene
PZ2	11/4/1999	Acetone, dichlorodifluoromethane, tetrachloroethene
	7/24/2000	1,2,4-trimethylbenzene, acetone, carbon disulfide, chloromethane, m/p-xylene, toluene
PZ3	11/4/1999	All sample results were below the reporting limit
	7/24/2000	1,1-dichloroethane, 4-ethyltoluene, 1,2,4-trimethylbenzene, acetone, benzene, carbon disulfide, chloromethane, chloroethane, chloroform, dichlorodifluoromethane, ethylbenzene, m/p-xylene, o-xylene, toluene, vinyl chloride

3.4 GEOPHYSICAL INVESTIGATION

A geophysical investigation was conducted between 9 and 18 February 2000, by IT/OHM to screen the site for buried metallic debris and fill soils. Geophysical techniques used included magnetic and electromagnetic (EM) induction methods. The magnetic data revealed the presence of several large areas indicative of the presence of buried metallic debris, including a large trench in the southwest portion of the survey area (anomaly A-1) and a large disposal area in the northeast portion of the survey area (anomalies A-2 and A-3) (Figure 3-1). Buried debris also appeared to have accumulated at the base of the slope along the northeastern edge of the survey area (anomaly A-4). Additionally, several buried metallic objects or small accumulations of debris (anomaly A-5) were identified southwest of the trench (referred to as anomaly A-1), and numerous very small pieces of metallic debris was identified southeast of trench A-1. The absence of large EM-31 anomalies associated with most of the magnetic anomalies indicated the metallic debris to be deeper than 5 feet in much of the site.

The EM-31 conductivity data revealed the presence of a large area of elevated electrical conductivity in the central portion of the survey area (anomaly A-6). This area was interpreted as containing fine-grained, clayey soils near the surface. Because much of the native soils at the site appear to consist of low-conductivity, clean sands deposited by Agua Chinon wash, it is likely that the conductive soils in the middle of the site are imported fill material. The surface area over which geophysical surveys were conducted encompasses 9 acres, and anomalies were identified over much of the surveyed area. Figure 3-1 shows the results of this geophysical investigation.

3.5 EXPLORATORY TRENCHING AND SUBSURFACE SOIL SAMPLING

Exploratory trenching was conducted during March 2000 and generally confirmed the results of the geophysical survey. Eighteen trenches/pits (1E to 7E, H1, H3 to H9, and, 9E and H2, each of which consist of two trenches) were excavated at the site. Subsurface soil sampling was conducted during trenching and data validation for the soil analytical results was performed in May 2000.

Twenty-two soil samples (plus two duplicates) were collected from trenches at depths ranging from 4 to 35 feet bgs. One-third of the soil samples analyzed were collected from depths of 4 to 10 feet bgs, with all remaining samples collected from greater depths. These soil samples were analyzed for TPH (both gasoline and diesel ranges), VOCs, semivolatile organic compounds (SVOCs), and metals (including mercury). Two out of the 24 soil samples were analyzed for dioxins/furans, asbestos, and perchlorate.

The analytes that were detected in the samples were predominantly TPH and arsenic. Two of the 24 samples analyzed for arsenic exceeded both the background levels and the preliminary remediation goals (PRGs). The remaining detections of arsenic were below Station background levels. Lead and benzo(a)pyrene (B[a]P) were detected in a single sample each, and both analytes had concentrations that exceeded the residential PRGs (EPA 2002a). The two soil samples (trench 4E at 6 feet and trench H3 at 4 feet) that were analyzed for dioxins and furans had detected concentrations of 1,2,3,4,6,7,8-heptachloro-dibenzodioxin (HPCDD), HPCDDs (total), heptachlorodibenzofuran (HPCDFs) (total), hexachloro-dibenzofuran (HXCDFs) (total), octachlorodibenzodioxin (OCDD) and octachlorodibenzofuran (OCDF). The calculated toxicity equivalency quotients (TEQ) for the samples (0.424 picograms per gram [pg/g] – 6 feet sample from trench 4E and 0.0476 pg/g – 4 feet sample from trench H3) were below the residential PRG of 3.9 pg/g for dioxins/furans. Table 3-3 presents the details of the subsurface soil sampling and Table 3-4 presents the summary of detected analytes of samples collected at various depths. Trench locations are shown on Figure 3-1.

3.5.1 Radiological Screening During Trenching

Radiological screening was conducted as a part of the trenching activity. The radiological screening was categorized as an initial characterization. The screening log indicates that the radiological readings of beta/gamma and alpha were below or equal to background concentrations. A more detailed soil radiological evaluation of the site is presented in Section 3.3.2 as part of the Station-wide radiological survey.

3.6 DELINEATION OF WASTE PLACEMENT

The primary objective of the trenching in March 2000 was to supplement and verify the results of the geophysical survey conducted during February 2000. The results of trenching also provided information on the characteristics of the debris placed at the site. However, even though waste delineation was not the primary objective, a few of the trenches were excavated to the limits of waste placement (Table 3-3 and Figure 3-1).

In order to provide boundaries for the sampling design of the RSE investigation, tentative waste placement boundaries were estimated using the pre-waste placement and post-waste placement topographs. The record search revealed the existence of pre-waste placement (circa 1972, with a 2-foot contour intervals) and post-waste placement (1990, with a 2-foot contour interval), (Figures 3-1 and 3-2, respectively, of the work plan). The pre- and post-waste placement topographic maps and the cross sections generated using these topographs were used to estimate the lateral extent of the waste placement, the interface of the fill material with the native soil, the volume of the fill, and depth of water relative to the fill material.

The lateral extent (boundary) was further verified by evaluating borehole logs of the wells installed at the site. A review of the borehole logs of the vadose zone wells (PZ1, PZ2, and PZ3) and the monitoring wells (MW01, MW02, and MW04) did not reveal any evidence of debris. Trench logs for trenches H4, H5, H6, H7, H8, 7E, and 8E (which extended across the perimeter of AA 3) also defined the limits of waste placement. A detailed description of waste placement boundary delineation is presented in the RSE work plan (Earth Tech 2002a).

As a result of this delineation activity, the maximum depth of waste was estimated at approximately 25–30 feet. Figure 3-1 shows the lateral extent of waste as a result of this exercise. These cross sections and the tentative waste placement boundary were used in the decision-making process of the RSE investigation sampling design. However, the waste placement boundaries were refined based on the RSE investigation trenching activity and are presented in Section 6.1 of this report.

3.7 EVALUATION OF RADIONUCLIDES

3.7.1 Groundwater

Investigations previously conducted at former MCAS El Toro identified radionuclides (gross alpha and gross beta emissions) in groundwater at concentrations exceeding federal drinking water standards (Earth Tech 2001). Table 3-1 shows the radionuclide concentrations exceeding the drinking water standards in the groundwater collected from AA 3. The Phase I radionuclide evaluation at the former landfill sites (IRP Sites 2, 3, and 5) and the Explosive Ordnance Disposal (EOD) Range (IRP Site 1) concluded that the origin of the radionuclides in the groundwater is natural, and not anthropogenic. An additional Phase II investigation was conducted by Earth Tech in 2001 and was documented in a technical memorandum (Earth Tech 2001). The study confirmed that there was no evidence that the gross alpha and gross beta emissions detected at former MCAS El Toro were caused by Marine Corps activities.

Table 3-3: Details of Subsurface Soil Sampling from Trenches – Previous Investigation

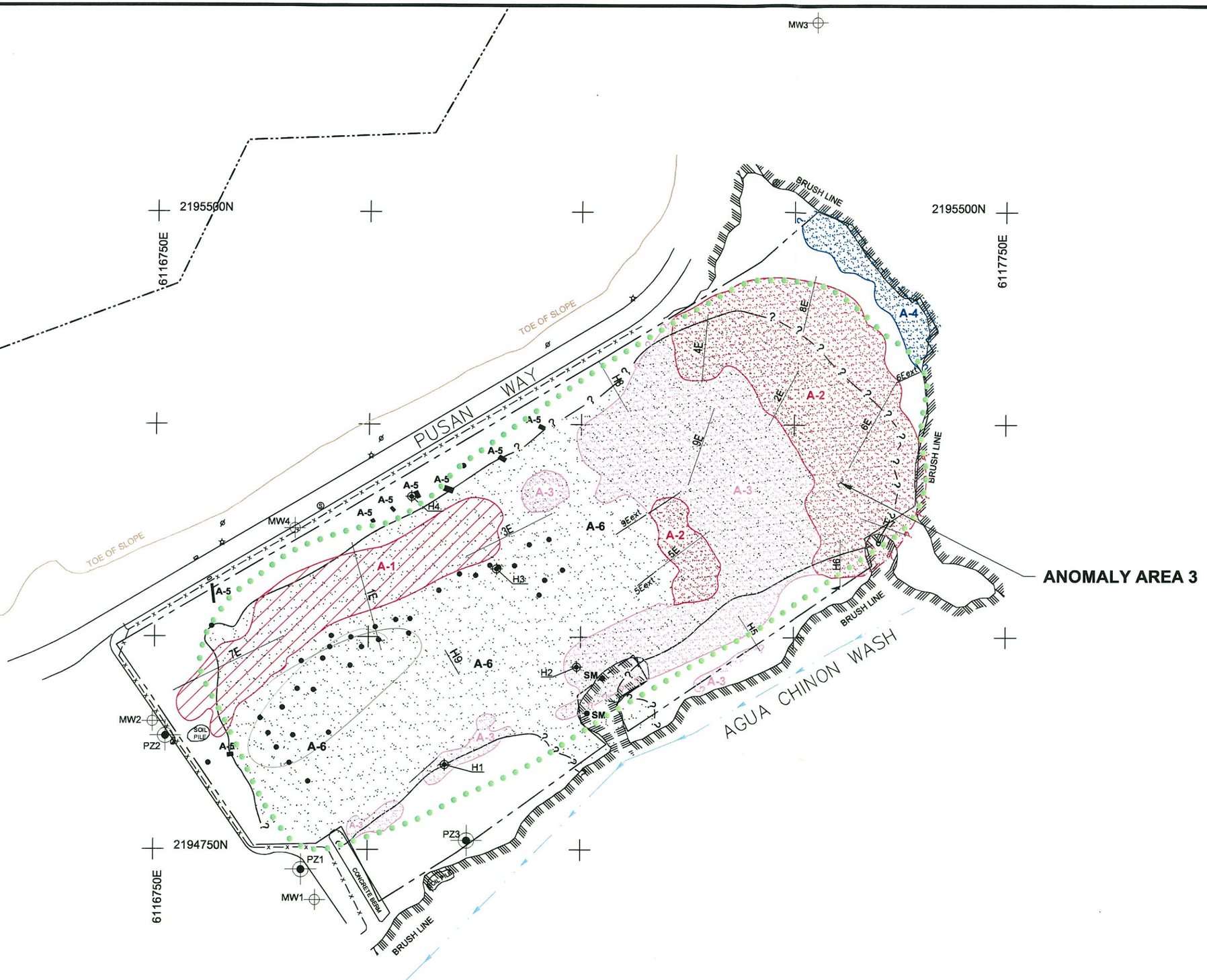
Trench number	Reason	Location	Materials Found	Sample ID	Depth (feet bgs)
1E	Bisected a portion of Anomaly A-1.	Orientation - NW to SE Location - Southwestern portion of A-1, approximately 24 feet from the fence demarcating the boundary	Excavated material was found to consist of clays and sands. Abundant quantities of concrete, rebar, and metallic debris.	20242-1096	16
				20242-1101	20
				20242-1099	22
2E	Intersecting anomalies A-2 and A-3	Orientation - SW to NE Location - Northeastern portion of the site	A strong petroleum odor was noted at 5 to 7 feet bgs. Construction debris was encountered from 9 to 22 feet bgs.	20242-1102	4
				20242-1103	22
3E	Intersecting anomalies A-1 and A-6	Orientation – NE to SW Location - North-central portion of the site	Debris was encountered from 16 to 23 feet bgs. However, minor amounts of debris were encountered between 6 and 16 feet bgs.	20242-1110	22
				20242-1114	22
				20242-1115	35
4E	Intersecting anomaly A-2	Orientation – N to S Location – NE corner of the site near the northern edge	A strong, sweet chemical odor was noted from 3 to 5 feet bgs. Concrete, rebar, polyvinyl chloride plastic bags, and heavy construction debris was encountered from 8 to 23 feet bgs.	20242-1109	6
5E	Intersecting anomalies A-2, A-3 and A-6	Orientation – NE to SW Location – central portion of the site	Heavy construction debris and large granodiorite boulders were encountered from 7 to 20 feet bgs. The extension trench had amounts of scattered debris and contained asbestos pipe.	20242-1108	10
				20242-1107	22
				20242-1117	22
				20242-1118 (dup)	22.5
6E	Intersecting anomaly A-2	Orientation – The orientation of the trench was NE to SW Location – NE portion of the site, near the hill. The northeastern extension of the trench extended to the northeasterly toe of the slope	Construction, rubble, and metal debris were encountered from 2 to 20 feet bgs.	20242-1104	22

Table 3-3: Details of Subsurface Soil Sampling from Trenches – Previous Investigation

Trench number	Reason	Location	Materials Found	Sample ID	Depth (feet bgs)
7E	Bisecting a portion of anomaly A-1	Orientation – NE to SW Location – SW portion of the site close to the fence demarcating the study area	A single soil pile was located near the trench. Construction debris, plastic, metal pipes, and asbestos pipes were encountered from 4 to 22 feet bgs.	20242-1116	22
8E	Intersecting portion of anomaly A-2	Orientation – N to S Location – NE portion of the site	Asphalt concrete, with thicknesses ranging from 2 to 3.5 inches, was located at depths of 10 to 12 feet bgs and was logged as a possible road or a cover.	—	—
9E	Bisecting a portion of anomaly A-3	Orientation – NE to SW Location – NW portion of the site	Construction debris, plastic, metal pipes, and asbestos pipes were encountered from 4 to 22 feet bgs.	—	—
H1	Intersecting anomaly A-3 and was extended beyond A-3 until the limits of debris were delineated.	Orientation – E to W Location – Lower SE portion of the site	Metal and plastic debris were encountered in the trenches.	20242-1098	10
H2	Trench and its extension bisect anomalies A-3 and A-6.	Orientation – NE to SW Location – central portion of the site toward Agua Chinon wash	Concrete, wood, metal debris, and plastic were encountered in the trenches.	20242-1097	6
H3	Intersecting anomaly A-6	Orientation – NW-SE to E-W Location – central portion of the site	Some concrete debris was encountered in the trench.	20242-1095	4
H4	Intersects anomalies A-5, A-6, and A-1	Orientation – NW-SE to E-W Location – central portion of the site south of Pusan Way	Construction debris and domestic refuse, such as milk containers, were encountered in the trench.	20242-1112	7
				20242-1113 (dup)	7.5
H5	Intersects anomaly A-3	Orientation – NW to SE Location – Center of southeastern boundary near Agua Chinon Wash	Construction debris including concrete rebar, metal debris, plastic, and rubber were encountered in the trench.	20242-1111	7

Table 3-3: Details of Subsurface Soil Sampling from Trenches – Previous Investigation

Trench number	Reason	Location	Materials Found	Sample ID	Depth (feet bgs)
H6	Intersects anomaly A-2	Orientation – N to S Location – near the boundary of the site along Aqua Chinon Wash	Some debris was encountered in the trench.	20242-1106	6
H7	Intersects anomaly A-2	Orientation – NE to SW Location – near the boundary of the site along Aqua Chinon Wash	Some debris was encountered in the trench.	20242-1105	18
H8	Intersects anomaly A-3	Orientation – NW to SE Location – near the NW boundary of the site along Pusan Way.	Some debris was encountered in the trench.	20242-1100	14
H9	Intersects anomaly A-6	Orientation – NW to SE Location – central portion of the site	Some debris was encountered in the trench.	—	—



PRIMARY SOURCE OF INFORMATION:
TECHNICAL INFORMATION PACKAGE (OHM 2000)

LEGEND

- BOUNDARY OF GEOPHYSICAL SURVEY AREA
- ESTIMATED EXTENT OF WASTE PLACEMENT BOUNDARY FOR RSE INVESTIGATION
- CHAIN-LINK FENCE
- AGUA CHINON WASH
- SEWER MANHOLE
- LIGHT POLE
- POWER POLE
- STORM DRAIN
- MW2 GROUNDWATER MONITORING WELL
- PZ2 VADOSE ZONE VAPOR WELL
- LINE INDICATES UNCERTAIN BOUNDARY

GEOPHYSICAL SURVEY RESULTS

- VERY SMALL BURIED METALLIC OBJECT/DEBRIS
- SM SURFACE METALLIC OBJECT/DEBRIS
- 5E TRENCH LOCATIONS
- H4 TRENCH/POTHOLE LOCATIONS
- A-1 LARGE TRENCH CONTAINING HIGH CONCENTRATION OF DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-2 DISPOSAL AREA CONTAINING HIGH CONCENTRATION OF DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-3 DISPOSAL AREA CONTAINING SCATTERED DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-4 AREA CONTAINING SHALLOW BURIED METALLIC/ CONSTRUCTION DEBRIS
- A-5 LARGE BURIED METALLIC OBJECT OR SMALL ACCUMULATION OF BURIED METALLIC DEBRIS
- A-6 AREA CONTAINING POSSIBLE IMPORTED FILL

NOTES:

1. COORDINATES ARE IN CALIFORNIA STATE PLANE COORDINATE SYSTEM, NAD83, ZONE 6.
2. INTERPRETED BOUNDARIES OF SUBSURFACE ANOMALIES ARE APPROXIMATE, QUERIED WHERE INFERRED OR UNCERTAIN.

NORTH

60 0 60 120 FEET

SCALE: 1"=120'

ESI Report — Draft

Previous Investigation Sampling Location and Results

Removal Site Evaluation for Anomaly Area 3

Date: 11-03	MCAS El Toro	Figure 3-1
Project No. 37380	EARTH TECH — A tyco INTERNATIONAL LTD. COMPANY	

File: G:\us\Long\Active\Remediation\NAVCLEAN\CTO-78\Anomaly Area 3\ESI Report\Figures - ESI Repo 3-1.dwg Time: Nov 05, 2003 - 3:04pm

e 3-4: Summary of Detected Analytes - Subsurface Soil - AA 3 Previous Investigation

	Sample ID:	20242-1095	20242-1102	20242-1109	20242-1106	20242-1097	20242-1112	20242-1111	20242-1113	20242-1098	20242-1108	20242-1100	20242-1105	20242-1096	20242-1099	20242-1101	20242-1103	20242-1110	20242-1114
	Location ID:	AA3-H3-01	AA3-2E-01	AA3-4E-01	AA3-H6-01	AA3-H2-01	AA3-H4-01	AA3-H5-01	AA3-H4-01	AA3-H1-01	AA3-5E-02	AA3-H8-01	AA3-H7-01	AA3-1E-01	AA3-1E-02	AA3-1E-03	AA3-2E-02	AA3-3E-01	AA3-3E-02
	Sample Type:	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Duplicate	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
	Sample Date:	03/06/96	03/07/96	03/07/96	03/07/96	03/06/96	03/08/96	03/08/96	03/08/96	03/06/96	03/07/96	03/06/96	03/07/96	03/06/96	03/06/96	03/06/96	03/07/96	03/08/96	03/08/96
Parameter	Sample Depth :	4.0'	4.0'	6.0'	6.0'	6.0'	7.0'	7.0'	7.5'	10.0'	10.0'	14.0'	18.0'	16.0'	22.0'	20.0'	22.0'	22.0'	22.0'
TPH (EPA Method 8015M)	Units																		
TPH as Diesel	mg/kg	11 U	5600	170	10.7 U	150	42	12	79	10.9 U	15	10.6 U	150	160	61	12 U	130	63	110
VOCs (EPA Method 8260)																			
2-Butanone (MEK)	µg/kg	160 U	79 U	62 U	53 U	120 U	64 U	53 U	65 U	60 U	50 U	59 U	160 U	73 U	90 U	78 U	66 U	67 U	52 J
Acetone	µg/kg	160 U	100	46 J	53 U	120 U	50 J	37 J	80	60 U	66	59 U	33 J	73 U	90 U	78 U	50 J	40 J	230 J
Benzene	µg/kg	16 U	7.9 U	6.2 U	5.3 U	12 U	6.4 U	5.3 U	1.7 J	6 U	5 U	5.9 U	16 U	7.3 U	9 U	7.8 U	6.6 U	6.7 U	6.3 U
Methylene chloride	µg/kg	16 U	9.2	6.2 U	5.3 U	12 U	6.4 U	5.3 U	6.5 U	6 U	5 U	5.9 U	14 J	7.3 U	9 U	7.8 U	7.7	6.7 U	6.3 U
Styrene	µg/kg	16 U	7.9 U	6.2 U	5.3 U	12 U	6.4 U	5.3 U	6.5 U	6 U	5 U	5.9 U	16 U	7.3 U	9 U	7.8 U	6.6 U	6.7 U	6.3 U
SVOCs (EPA Method 8270)																			
Benzo[a]anthracene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	270 J	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Benzo[a]pyrene	µg/kg	280 U	16000 U	190 U	35 U	1400 U	1300 U	230	1400 U	270 U	38 U	270 U	2700 U	140 J	39 U	300 U	1500 U	310 U	2900 U
Benzo[b]fluoranthene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	440	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Chrysene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	250 J	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Diethyl phthalate	µg/kg	360 U	21000 U	1800 U	96 J	1800 U	1800 U	260 J	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	100 J	2000 U	400 U	3800 U
Fluoranthene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	600	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Indeno[1,2,3-cd]pyrene	µg/kg	360 U	21000 U	190 U	35 U	1800 U	1800 U	81	1800 U	360 U	38 U	350 U	3500 U	63 J	39 U	400 U	2000 U	400 U	3800 U
Phenanthrene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	140 J	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Pyrene	µg/kg	360 U	21000 U	1800 U	350 U	1800 U	1800 U	460	1800 U	360 U	380 U	350 U	3500 U	1700 U	390 U	400 U	2000 U	400 U	3800 U
Metals (EPA Method 6010B)																			
Antimony	mg/kg	11 UJ	10.5 U	11.2 U	10.7 U	11 UJ	10.7 U	10.6 U	10.9 U	10.9 UJ	11.4 U	10.6 UJ	10.7 U	46 J	12 UJ	12 UJ	12.1 U	12.2 U	11.5 U
Arsenic	mg/kg	3.05	2.12	2.49	1.81	4.63	4.59	2.85	4.35	3.45	3.23	3.98	1.85	211	4.04	6.78	6.47	4.92	6.56
Barium	mg/kg	112	79.4	76	73	101	104	62.3	106	98.3	83.5	79.7	83.9	360	156	156	101	86.8	100
Beryllium	mg/kg	.459 U	.294 U	.298 U	.219 U	.361 U	.459 U	.215 U	.407 U	.419 U	.391 U	.533 U	.253 U	.63 U	.558 U	.618 U	.419 U	.35 U	.467 U
Cadmium	mg/kg	1.1 U	1.05 U	1.12 U	1.07 U	1.1 U	1.07 U	1.06 U	1.09 U	1.09 U	1.14 U	1.06 U	1.07 U	2.42	1.2 U	1.2 U	1.35	1.22 U	1.15 U
Chromium	mg/kg	10.2	10.4	7.04	4.4	13.2	15.8	12.9	16.9	12.3	9.16	13.2	6.88	53.1	14.9	21.1	23.8	16	14.1
Cobalt	mg/kg	3.73	5.33	3.09	2.54	4.18	5.8	2.97	4.52	4.32	3.5	6.1	2.92	72.8	6.74	4.97	4.03	2.21	4.31
Copper	mg/kg	6.56	10.7	6.48	3.04	9.28	12.7	5.82	12.6	6.56	6.2	11.3	4.35	2040	12.4	7.9	17.2	4.3	25.8
Lead	mg/kg	5.47	9.36	9.72	2.22	12.4	14.7	3.87	11.9	3.58	3.56	3.4	6.47	677	4.42	5.1	24.6	2.96	6.13
Manganese	mg/kg	211 J	231	156	144	214 J	250	145	213	181 J	123	125 J	149	1350 J	270 J	185 J	175	124	169
Molybdenum	mg/kg	2.2 UJ	2.1 U	2.24 U	2.14 U	2.19 UJ	2.15 U	2.13 U	2.17 U	2.19 UJ	2.29 U	2.13 J	2.14 U	490 J	3.2 UJ	2.4 UJ	7.81	2.45 U	2.3 U
Nickel	mg/kg	7.14	13.7	5.03	2.14 U	8.79	11.6	7.98	10.3	8.07	5.15	9.71	4.92 U	25.4	10.7	11.5	9.87	6.61	8.51
Selenium	mg/kg	1.1 U	1.05 U	1.12 U	1.07 U	1.1 U	1.07 U	1.06 U	1.09 U	1.09 U	1.14 U	1.06 U	1.07 U	3.4	1.2 U	1.2 U	1.21 U	1.22 U	1.15 U
Thallium	mg/kg	1.19 U	1.05 U	1.12 U	1.07 U	1.32 U	1.07 U	1.06 U	1.09 U	1.09 U	1.14 U	1.06 U	1.07 U	3.98	1.2 U	1.22 U	1.21 U	1.22 U	1.15 U
Vanadium	mg/kg	27.4	35.6	19.7	16.9	27.3	29.5	18	26.9	32.6	22.8	37.9	20	38.1	43.4	43.2	39.7	25.8	33.8
Zinc	mg/kg	37.7 J	45.9 J	35.9	26.2	43 J	50.7	26.2	45.9	36.4 J	32.5	34.1 J	27.5 J	6030 J	88 J	52.6 J	72 J	34.7	37.6
Dioxins/Furans (EPA Method 8290)																			
1,2,3,4,6,7,8-HPCDD	pg/g	4.3 J	NA	39	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	pg/g	1.7 U	NA	2.7 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8,9-HPCDF	pg/g	0.72 U	NA	0.99 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-HCDD	pg/g	0.64 U	NA	0.86 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-HCDF	pg/g	0.41 U	NA	0.68 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-HCDD	pg/g	0.68 U	NA	1.5 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-HCDF	pg/g	0.39 U	NA	0.66 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-HCDD	pg/g	0.91 U	NA	1.1 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-HCDF	pg/g	0.77 U	NA	0.80 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-PECDD	pg/g	0.82 U	NA	1.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-PECDF	pg/g	0.49 U	NA	0.74 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-HCDF	pg/g	0.42 U	NA	0.71 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,7,8-PECDF	pg/g	0.48 U	NA	0.73 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,7,8-TCDD	pg/g	0.79 U	NA	0.78 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,7,8-TCDF	pg/g	0.42 U	NA	0.66 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HPCDDs (total)	pg/g	8.6	NA	66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HPCDFs (total)	pg/g	1.8	NA	6.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HCDDs (total)	pg/g	0.88 U	NA	4.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HCDFs (total)	pg/g	0.77 U	NA	1.6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	pg/g	40	NA	330 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDF	pg/g	5.9 J	NA	10 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PECDDs (total)	pg/g	0.82 U	NA	1.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PECDFs (total)	pg/g	0.77 U	NA	2.0 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCDDs (total)	pg/g	0.79 U	NA	0.78 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCDFs (total)	pg/g	0.54 U	NA	0.66 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TEQ (Total 2,3,7,8-TCDD)	pg/g	0.048	NA	0.424	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

3-4: Summary of Detected Analytes - Subsurface Soil - AA 3 Previous Investigation

	Sample ID:	20242-1107	20242-1117	20242-1118	20242-1104	20242-1116	20242-1115
	Location ID:	AA3-5E-01	AA3-5E-03	AA3-5E-03	AA3-6E-01	AA3-7E-01	AA3-3E-03
	Sample Type:	Regular	Regular	Duplicate	Regular	Regular	Regular
	Sample Date:	03/07/96	03/09/96	03/09/96	03/07/96	03/08/96	03/08/96
Parameter	Sample Depth :	22.0'	22.0'	22.5'	22.0'	22.0'	35.0'
TPH (EPA Method 8015M)	Units						
TPH as Diesel	mg/kg	13	220	130	260	370	1100
VOCs (EPA Method 8260)							
2-Butanone (MEK)	µg/kg	52 U	10 J	13 J	100 U	52 U	11 J
Acetone	µg/kg	46 J	31 J	98	100 J	52 U	77
Benzene	µg/kg	5.2 U	5.9 U	5.9 U	10 U	5.2 U	5.9 U
Methylene chloride	µg/kg	5.2 U	3.2 J	34	11	3 J	2.7 J
Styrene	µg/kg	5.2 U	5.9 U	5.9 U	10 U	32	5.9 U
SVOCs (EPA Method 8270)							
Benzo[a]anthracene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Benzo[a]pyrene	µg/kg	290 U	590 U	290 U	2900 U	1000 U	290 U
Benzo[b]fluoranthene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Chrysene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Diethyl phthalate	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Fluoranthene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Indeno[1,2,3-cd]pyrene	µg/kg	390 U	780 U	390 U	3800 U	1000 U	390 U
Phenanthrene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Pyrene	µg/kg	390 U	780 U	390 U	3800 U	10000 U	390 U
Metals (EPA Method 6010B)[a]							
Antimony	mg/kg	11.7 U	11.8 U	11.7 U	11.5 U	10.4 U	11.7 U
Arsenic	mg/kg	7.74	3.25	3.05	2.99	2.6	4.82
arium	mg/kg	68.5	88.6	93.5	95.5	55.5	98.1
Beryllium	mg/kg	.378 U	.357	.383	.302 U	.29	.499
Cadmium	mg/kg	1.17 U	1.18 U	1.17 U	1.15 U	1.84	1.17 U
Chromium	mg/kg	8.3	7.29	8.08	9.34	10.8	11.2
Cobalt	mg/kg	3.43	3.27	3.6	3.55	6.97	4.36
Copper	mg/kg	4.79	7.48	7.12	6.92	11.1	7.91
Lead	mg/kg	3.7	4.73	3.93	5.53	122	4.39
anese	mg/kg	91.2	138	136	168	181	107
bdenum	mg/kg	2.35 U	2.37 U	2.35 U	2.29 U	2.07 U	2.34 U
Nickel	mg/kg	5.32	7.28	7.4	6.79	8.26	7.12
Selenium	mg/kg	1.17 U	1.18 U	1.17 U	1.15 U	1.04 U	1.17 U
Thallium	mg/kg	1.17 U	1.18 U	1.17 U	1.15 U	1.04 U	1.17 U
Vanadium	mg/kg	20.8	20.6	22.6	25.9	21.6	26.8
Zinc	mg/kg	21.9	37.5	34.7	39.2 J	146	32.5
Dioxins/Furans (EPA Method 8290)							
1,2,3,4,6,7,8-HPCDD	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8,9-HPCDF	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-HCDD	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-HCDF	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-HCDD	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-HCDF	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-HCDD	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-HCDF	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,7,8-PECDD	pg/g	NA	NA	NA	NA	NA	NA
1,2,3,7,8-PECDF	pg/g	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-HCDF	pg/g	NA	NA	NA	NA	NA	NA
2,3,4,7,8-PECDF	pg/g	NA	NA	NA	NA	NA	NA
2,3,7,8-TCDD	pg/g	NA	NA	NA	NA	NA	NA
2,3,7,8-TCDF	pg/g	NA	NA	NA	NA	NA	NA
HPCDDs (total)	pg/g	NA	NA	NA	NA	NA	NA
HPCDFs (total)	pg/g	NA	NA	NA	NA	NA	NA
HCDDs (total)	pg/g	NA	NA	NA	NA	NA	NA
HCDFs (total)	pg/g	NA	NA	NA	NA	NA	NA
OCDD	pg/g	NA	NA	NA	NA	NA	NA
OCDF	pg/g	NA	NA	NA	NA	NA	NA
PECDDs (total)	pg/g	NA	NA	NA	NA	NA	NA
PECDFs (total)	pg/g	NA	NA	NA	NA	NA	NA
TCDDs (total)	pg/g	NA	NA	NA	NA	NA	NA
TCDFs (total)	pg/g	NA	NA	NA	NA	NA	NA
TEQ (Total 2,3,7,8-TCDD)	pg/g	NA	NA	NA	NA	NA	NA

why no 96

S:
icates the analyte was not detected at or above the stated limit.
ndicates the analyte was not detected at or above the stated limit. The sample dete
J = indicates an estimated value.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
pg/g = picogram per per kilogram

NA = not analyzed

TPH = total petroleum hydrocarbons
EPA = Environmental Protection Agency
PRG = preliminary remediation goals
VOCs = volatile organic compounds
SVOCs = semivolatile organic compounds
AA3 = Anomaly Area 3
RSE = Removal Site Evaluation

The report recommended that once the results of the ongoing radiological survey are available, the current monitoring for radionuclides be reevaluated. In addition, no further evaluation of the origin of the radionuclides in groundwater was deemed necessary.

3.7.2 Soil

3.7.2.1 Historical Radiological Assessment

The Historical Radiological Assessment (HRA) was conducted to identify sources of radioactive material/contamination and assess the likelihood of contaminant migration, thereby identifying sites that needed further action as opposed to no threat to human health. The HRA also provided initial classification (impacted or non-impacted) for former MCAS El Toro sites. The HRA included the review of Navy, MCAS El Toro, and SWDIV correspondence, historical files and related reports, personnel interviews, site inspections, and limited informal surveys. The HRA for former MCAS El Toro was issued in May 2000 (Weston 2000a).

3.7.2.2 Radiological Survey Plan

Based on information provided in the HRA, a Radiological Survey Plan (Weston 2000b) was prepared to outline the specifications for radiological characterization of sites selected based on the HRA at former MCAS El Toro. The HRA and the Radiological Survey Plan identified the main radioisotopes of concern at El Toro as radium (Ra-226) and strontium (Sr-90), which are historically used in aircrafts stationed at the base. Other radioisotopes that may have been present at former MCAS El Toro include thorium (Th-232), cobalt (Co-60), krypton (Kr-85), and tritium (Hydrogen [^{3}H]).

The onsite radiological characterization and laboratory analyses were completed in November and December 2001, respectively. Results of the surveys performed as part of the Radiological Survey Plan (Weston 2000b), along with the evaluation, assessment, and recommendations necessary for the radiological release of specified areas at former MCAS El Toro will be presented in the Draft Radiological Release Report for former MCAS El Toro.